

# The Material Politics of Finance: The Ticker Tape and the London Stock Exchange, 1860s–1890s

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JOHN HANDEL

When the ticker tape was first invented in the 1860s, it promised a revolution in financial markets. Pricing information was now no longer solely the domain of the trading floor but was relayed continuously and simultaneously to ticker tapes long distances away from the stock exchange. Both nineteenth-century financiers, and the modern scholars who study them, have been enamored with the ticker tape and how it changed the way financial markets were perceived and experienced. However, a focus on how nineteenth-century financiers read and responded to the ticker tape has missed the real reordering of power that the ticker helped usher in. This article argues that between the 1860s and 1890s the London Stock Exchange and the Exchange Telegraph Company powerfully centralized their control over the distribution and transmission of financial information through the mundane infrastructures that underpinned the ticker tape system. Seeming technicalities, like the placement of batteries, the construction of electrical circuits, and the laying of wires and cables, were leveraged by these institutions to create a ticker tape system that distributed financial information unequally to financiers and investors throughout Britain. By the end of the nineteenth century, social and political questions about who should

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have access to financial information and markets, and on what terms, became helplessly intertwined with the mundane technicalities of the material infrastructures of modern finance.

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## Introduction

Were you to believe the existing scholarship, it would seem exceedingly easy to write a history about the relationship between finance and technology in the nineteenth century. The formula is simple, and it goes something like this: the introduction of telecommunications, in particular the telegraph, the ticker tape, and the telephone, connected geographically distant markets, increased the amount of investors who had access to those markets, and facilitated global arbitrage trading which closed pricing discrepancies and helped make markets more efficient and integrated by the turn of the twentieth century.<sup>1</sup>

Of the nineteenth century's triumvirate of financial technologies, the ticker tape is regarded as the most important because it encapsulated two distinct approaches to understanding financial markets. The first approach emphasizes how technological innovation creates more efficient markets. In the case of the ticker tape, the continuous, simultaneous distribution of price information over large geographical distances permitted "broad public participation" in financial markets and "stimulated arbitrage activities" between different markets, eliminating both informational asymmetries and price discrepancies.<sup>2</sup> The second approach highlights how the ticker tape ushered in an entirely new way of seeing and experiencing modern financial markets. According to Alex Preda, the ticker tape

replaced a ragged temporal structure with a smooth one, with the consequence that price variations became visualizations of market

1. There are too many studies that make these claims to list here. Some of the most notable are Ferderer, "Advances in Communication Technology and Growth of the American Over-the-Counter Markets"; Hoag, "The Atlantic Telegraph Cable and Capital Market Information Flows"; Müller and Tworek, "The Telegraph and the Bank"; Michie, "Friend or Foe?"; Michie, *The London Stock Exchange*; Michie, *The London and New York Stock Exchanges*; Kynaston, *The City of London*.

2. Quotes are respectively from Hochfelder, "Where the Common People Could Speculate," 336; and Preda, *Framing Finance*, 140. Preda's claim is somewhat misleading. In Britain, the ticker tape did stimulate arbitrage activity between provincial stock markets and the London Stock Exchange. However, contrary to Preda's claim, the ticker tape did not circulate prices between the London and New York Stock Exchanges as this article later shows. Prices between these markets were almost exclusively provided by telegraph.

transactions and objects of symbolic interpretation. Market exchanges were made visible as they happened, were disentangled from local conversations, and transformed into something which is both abstract and visible in several forms to everybody at once.<sup>3</sup>

As Peter Knight has succinctly put it: “Reading the market came to mean reading the ticker tape.”<sup>4</sup>

There are numerous issues with both of these approaches. For one, recent research has suggested that the ticker tape did not increase market efficiency but rather led to irrational behavior from investors as they chased the momentum of price changes they saw on the ticker.<sup>5</sup> Moreover, while the reminiscences of nineteenth-century financiers and investors undoubtedly attest to the creation of a new “social imaginary” of the market that was embodied by the ticker tape and experienced via the thrill of the “sensation as the quotations made their appearance on the tape,” scholars have overfocused on these *visions* of the market at the expense of its messy, underlying reality.<sup>6</sup> Despite the fact that the ticker “imbued [the market] with a humanlike agency that was decidedly irrational, uncanny and supernatural,” the market was never reducible to the abstraction of the prices as they appeared on the ticker tape.<sup>7</sup>

This article proposes a new framework for understanding the history of the ticker tape in particular and the relationship between finance and technology more broadly. Rather than focusing on the experiences of those reading the ticker tape, this article examines how ticker tape companies and stock exchanges produced and transmitted the numbers that were read. The ticker tape was never simply a technological fix that improved market access and efficiency. Instead, the ways ticker tape companies chose to mark prices that they sent over their wires, how they constructed their physical networks of transmission, and how they decided who could have a ticker tape created new relations, exclusions, hierarchies, and forms of power within financial markets.<sup>8</sup>

3. Preda, *Framing Finance*, 142.

4. Knight, *Reading the Market*, 60.

5. See Bliss, Warachka, and Weidenmier, “What Makes Uninformed Traders Tick?”

6. I borrow the term “social imaginary” from Taylor, *Modern Social Imaginaries*. Following Taylor, Patrick Joyce and Chandra Mukerji have argued that because social life is performative and relies on collective visions of what should be performed, “things”—physical objects—became critical tools through which a common culture or social imaginary is encouraged and reproduced. The ticker tape is one such example. See Joyce and Mukerji, “The State of Things.” Second quote is from Hochfelder, “Where the Common People Could Speculate,” 339.

7. Knight, *Reading the Market*, 60.

8. Patrick Joyce and Juan Pablo Pardo-Guerra have both recently argued that we should examine technology and infrastructures for how they reorder, and are reordered by, social relations. See Joyce, *The State of Freedom*; Pardo-Guerra, *Automating Finance*.

In short, the most important effect of the ticker tape was not increased market efficiency but how it recalibrated the social relations and distribution of power within nineteenth-century financial markets.

Control over information and its circulation has always been a central concern of financial markets and financiers.<sup>9</sup> However, the introduction of telecommunications to financial markets during the nineteenth century marked a significant shift in the speed at which financial information was communicated and how easily it was made accessible. In the years after 1872, when the Exchange Telegraph Company (Extel) first began working the ticker tape in the London Stock Exchange, there was dramatic growth in ticker tape usage and an attendant expansion of investors.<sup>10</sup> Smaller investors and outside brokers—brokers not licensed to enter the formal London Stock Exchange and conduct business—were able to deal extensively thanks to the pricing information provided via the ticker tape.<sup>11</sup> But this growth was kept in check through the material politics of ticker tape infrastructure and network design. Rather than an abstract, simultaneous, and decentralized market that many people experienced at the same time via the prices on the ticker tape, the London Stock Exchange and Extel used the underlying infrastructures of the ticker tape—from batteries, cables, electrical circuits, to the instruments themselves—to centralize control over the transmission of financial information and to limit the ability of outsiders to trade on the London Stock Exchange's prices. In other words, the material infrastructures of ticker tape shaped the conditions of possibility and field of agency for financial decision-making in the late nineteenth century.<sup>12</sup> By the 1890s, however, the material infrastructures of the ticker tape alone were no longer enough for the London Stock Exchange and Extel to keep outside brokers at bay. The infrastructures of the ticker tape had inadvertently created new and lasting relationships between outside brokers and inside brokers rendering the technology of the ticker tape itself increasingly superfluous.

### Origins

The ticker tape was invented in America by Edward Calahan in 1867 as a response to a very particular problem of nineteenth-century financial

9. For some examples of this across different historical periods, see Vega, *Confusion de Confusiones*, 9–12; Ogborn, *Indian Ink*, 157–197; Poovey, “Writing about Finance in Victorian England,” 39–57; Zaloom, *Out of the Pits*, 141–160; Lewis, *Flash Boys*.

10. See Rutterford and Sotiropoulos, “The Rise of the Small Investor in the United States and United Kingdom.”

11. Taylor, “Inside and Outside the London Stock Exchange”; and Robb, *Ladies of the Ticker*, 41.

12. My approach draws largely from Joyce, *The Rule of Freedom*, 11–12; and Winner, “Do Artifacts Have Politics?”

markets: crowds. One afternoon, near the New York Stock Exchange, Calahan was thrown into the street by a crowd of messenger boys “pushing [and] yelling out the prices ... and rushing back again.” The “noise and confusion” of the stock exchange had ruined his day. Calahan thought he could fix this problem by furnishing stock prices “through some system of telegraphy.”<sup>13</sup> Calahan’s invention was introduced to the floor of the New York Stock Exchange later that same year, and he eventually sold the patent to Western Union.<sup>14</sup>

The ticker tape worked like this: company reporters walked around the different markets on the trading floor (different classes of securities were traded in different locations of nineteenth-century stock exchanges) and recorded the current prices of particular securities. The reporters then passed the prices to telegraph operators stationed on the stock exchange floor. The operator telegraphed the price to the central office a few blocks away. From the central office, the price was simultaneously transmitted out over a host of different circuits to all the connected ticker tapes. Ticker tape machines themselves were typically stationed in stockbrokers’ offices, where brokers, clerks, and investors waited to watch the price fluctuations of the market. The early ticker tape included a wheel of paper that was fed under two electrically charged printing wheels, one which had numbers and one which had letters. As the paper was fed through the wheels, the electrical signal from the central office animated the printing wheels, and the abbreviation of the stock and the recorded price were printed out. Some ticker tapes were merely placed on office desks or tables, whereas others were installed on columns under which the electric wiring was protected.

Although the mechanical operations of the ticker tape were similar on both sides of the Atlantic, American and British financial markets had “radically different” approaches for implementing and regulating the ticker tape system.<sup>15</sup> In nineteenth-century America, the power of individual stock exchanges to control the production and transmission of prices via the ticker tape was dwarfed by the power of Western Union. Western Union’s massive, nationwide telegraphic transmission network gave it such a large customer base that the company dictated the terms of ticker tape services to stock exchanges, not the other way around. The American legal system reinforced Western Union’s power. Until 1905—when the Supreme Court ruled stock exchange price

13. Calahan, “The Evolution of the Stock Ticker,” 236.

14. Preda, *Framing Finance*, 115; Michie, *The London and New York Stock Exchanges*, 174.

15. London Stock Exchange, Managers Minutes of Subcommittees relating to the Exchange Telegraph Co, MS/14608/03, 172, Guildhall Library.

quotations were the property of exchanges themselves—the courts had sided with Western Union and bucket shops throughout America, upholding the company’s rights to distribute quotations to whomever it chose. Outside of legal channels, stock exchanges began combatting Western Union by launching their own ticker tape services. In 1890, the New York Stock Exchange purchased the Commercial Telegram Company, which it promptly renamed the New York Quotation Company. The exchange used the new company to supply exclusive ticker tape services to its official members.<sup>16</sup>

The story is a different one in Britain. From the start, the London Stock Exchange sought to exert more control over the information transmitted by the ticker tape. The managers of the exchange worried that it was “not desirable to admit any person in the house for [ticker tape services] as they had no guarantee but that prices might be wired to other places than the offices of brokers and might tend to the formation of markets elsewhere.”<sup>17</sup> Shortly after the ticker tape was introduced to the New York Stock Exchange in 1868, Western Union tried, and failed, to introduce the ticker to the London Stock Exchange.<sup>18</sup> In 1872, Extel was formed with the goal of introducing ticker tape services to English financial markets.<sup>19</sup> Like their American counterparts, Extel’s first request for entry to the London Stock Exchange in May of 1872 was declined. It was only in November of 1872, alongside a petition with the names of 655 members of the exchange, that the managers of the London Stock Exchange finally relented and allowed Extel to “fix their apparatus in the settling room for one month as an experiment.”<sup>20</sup> The London Stock Exchange imposed one other set of conditions. Extel was granted a virtual monopoly over the collection and distribution of prices but only if those prices were sent to “members of the house exclusively.”<sup>21</sup> Over time, this would come to be one of the most controversial and impactful regulations on the operation of the ticker tape.

Extel faced another regulatory problem that Western Union did not: the nationalization of the telegraph in Britain. The British General Post Office (GPO) closely guarded its monopoly over telegraph services and

16. Hochfelder, *The Telegraph in America*, 130–134.

17. London Stock Exchange, Trustees and Managers Minutes, 1868–1872, MS/19297/6, 43, Guildhall Library.

18. *Ibid.*

19. The only history of Extel to date is Scott, *Extel 100*. This primarily relies on interviews with employees and includes almost no archival sources.

20. London Stock Exchange, Trustees and Managers Minutes, 1872–1874, MS/19297/7, 76, Guildhall Library. Mary Poovey mistakenly claims that the ticker was introduced to the London Stock Exchange in 1867. It was not. Poovey, *The Financial System in Nineteenth-Century Britain*, xv.

21. London Stock Exchange, Trustees and Managers Minutes, 1872–1874, MS/19297/7, 43, Guildhall Library.

worried that Extel's ticker tape would erode the local telegraph business. It thus imposed two additional conditions for granting Extel a license to operate. The first was that prices could only be circulated within a nine-hundred-yard radius of the Stock Exchange "because it was thought that no postal telegrams would be sent over so short a distance and that therefore the [telegraph] department would lose nothing."<sup>22</sup> Secondly, the GPO stipulated that "no subscribers office shall be used for the reception of telegrams by or on behalf of the company," to prevent the unfair distribution of prices to some subscribers before others.<sup>23</sup>

The skepticism of the GPO and the London Stock Exchange toward the ticker tape went beyond basic concerns of profit and loss. What was at stake was who would have access to the market. The telegraph had initially been introduced to financial markets with abandon because of the limited nature of its access points.<sup>24</sup> The London Stock Exchange and the GPO were both worried about the wider market access that the ticker tape promised. If the ticker tape would make the market "abstract and visible in several forms to everybody at once," as Preda has claimed, how could this power be restricted to only qualified, socially acceptable people? Moreover, how could the information sent out over the ticker be deemed as reliable and its fair and equal distribution ensured? Both the London Stock Exchange, the GPO, and Extel turned to technological solutions for many of these problems, but in doing so they inadvertently created a new set of social dynamics that reshaped nineteenth and early twentieth-century financial markets.

### Collecting and Reporting Prices

A central contradiction lay at the heart of Extel's ticker tape service. On the one hand, Extel's principal clients were stock *brokers* who monitored changing prices from their offices and informed their waiting investors about market movements. On the other hand, Extel relied almost entirely on stock *jobbers* for the prices it sent out over the ticker. Jobbers were the market makers of the London Stock Exchange. They stood on the trading floor and made prices all day while brokers attempted to place orders from clients. This meant that almost no

22. GPO Memorandum, 29 October 1874, Exchange Telegraph Company License, File 14, Post/30/371A, British Telecom Archive.

23. GPO Memorandum, 24 June 1872, Exchange Telegraph Company License, File 5, Post/30/371A, British Telecom Archive.

24. See Otter, "Making Liberal Objects," 575; London Stock Exchange, Trustees and Managers Minutes, 1842–1852, MS/19297/3, 184, Guildhall Library.

jobbers subscribed to the ticker service. “Jobbers,” Extel reported, “have no other use for [ticker tape] instruments.”<sup>25</sup> Although the distinction between brokers and jobbers had long existed in the London Stock Exchange, the ticker tape changed the relationship between the two groups by stripping away many of the social dynamics of price negotiations. Before the ticker tape, prices were determined through a complicated set of social and economic assessments that brokers and jobbers made about each other. Brokers and jobbers knew the reputations of the firms they dealt with. Brokers tended to prefer jobbing firms with larger capital reserves that they believed were of a “more responsible character.” Jobbers, on the other hand, were wary about making prices for any transaction that they suspected was “speculative” in nature.<sup>26</sup> Jobbers competed against one another to make a better price for a broker trying to place an order.<sup>27</sup> Brokers and jobbers also used price negotiations to “control what firms [they] wanted to trade with.”<sup>28</sup> Bad prices were made for untrustworthy firms, whereas firms that were trusted and respected were given certain advantages. The ticker tape seemed to flatten these negotiations from a dynamic, social interaction into what appeared to be an objective and neutral price that investors acted on without worrying about the dynamics of the trading floor. However, rather than ever reporting “objective” prices, the ticker tape transmitted prices that were products of new forms of social competition on the stock exchange floor. The social dynamics of price negotiation between brokers and jobbers were translated into a new medium and were reshaped by the ticker tape, but they never disappeared.

In fact, almost everyone connected to finance in the late nineteenth century regarded the prices reported by the ticker tape as inherently untrustworthy and unreliable. Suspicions that Extel’s low-level clerks and operators could be bribed to “send out a fake price” constantly plagued the company.<sup>29</sup> Official stockbrokers of the London Stock Exchange believed that the ticker tape service was “worked in the

25. Exchange Telegraph Company, Annual General Meetings, 1886, MS22964/1, London Metropolitan Archives.

26. *Royal Commission on Origin, Objects, and Constitution of the London Stock Exchange*, 1878, 44–45, Parliamentary Papers.

27. *Ibid.*, 98.

28. Attard, “The Jobbing System of the London Stock Exchange: An Oral History.”

29. Exchange Telegraph Company, Correspondence, Reports, etc. Relating to the London Stock Exchange, 1877–1897: Queries by Sir James Anderson, MS/23028, London Metropolitan Archives. Some of the actual fraud perpetrated by outside brokers via the ticker tape is explored in Porter, “‘Speciousness Is the Bucketeer’s Watchword.’” Similar fears also pervaded America. See Hochfelder, *The Telegraph in America*, 111–112.



interest of certain outside operators,” and that the way it was “mismanaged [was] nothing short of a disgrace.”<sup>30</sup> Alternatively, outside brokers believed that the ticker tape system was rigged against them in favor of those inside the stock exchange. “The speculator stands at a great disadvantage when dealing at tape prices,” the outside firm of Cochrane and Son argued, “for the instrument does not always record close market prices.”<sup>31</sup> The numbers reported by the ticker tape were trusted by few in the late nineteenth-century financial world.

The problem of trusting the prices reported over the ticker was exacerbated by the speed at which prices were transmitted. “There is a shout” of a price at which a deal was done, and “it is telegraphed all over the country immediately,” one broker described.<sup>32</sup> To the frustration of many, the ticker service was often littered with errors in prices or stock notation.<sup>33</sup> William Davies, the managing director of Extel, attempted to explain away these errors. Extel never sent out “marked” prices over the ticker tape but rather reported the “price bid or offered.” His reporters, he claimed, simply sent out prices as “they overhear [them].”<sup>34</sup> This meant that a deal had not necessarily occurred at the prices reported. Extel’s operators simply sent out whatever prices they heard being yelled on the scrum of the trading floor, not the prices of confirmed transactions. Once again, this was a marked difference from the American system. Financiers in London complained of the “vastly better” ticker tape system in the New York Stock Exchange, where “all bargains done on the floor of the exchange [were] immediately recorded on the tapes” and “at once reported to clients” via twenty-two reporters and four telegraphists who worked on the trading floor.<sup>35</sup> In contrast, Extel had only four reporters and two telegraphists on the trading floor of the London Stock Exchange, to say nothing of its informal and unsystematic price-reporting practices. Whereas the ticker tape system in New York seemed to marry speed with accuracy, in London, transmitting pricing information with speed actively worked against reporting accurate or objective market prices at which deals had been transacted.

30. “Tape Prices,” *Financial Times*, November 14, 1888, 2.

31. Cochrane and Sons, stockbrokers. *Times*, November 13, 1885, 15.

32. *Royal Commission on Origin, Objects, and Constitution of the London Stock Exchange*, 1878, 340, Parliamentary Papers.

33. See, for example, “The Tape and Mining Prices,” *Financial Times*, March 2, 1895, 3; London Stock Exchange, Managers Minutes of Subcommittees relating to the Exchange Telegraph Co, MS/14608/03, 54–55, 72, Guildhall Library.

34. *Royal Commission on Origin, Objects, and Constitution of the London Stock Exchange*, 1878, 351, Parliamentary Papers.

35. London Stock Exchange, Managers Minutes of Subcommittees relating to the Exchange Telegraph Co, MS/14608/03, 172, Guildhall Library.

Attempting to reconcile speed with accuracy forced Extel to rely on certain trusted jobbers for information about prices within particular markets. Skeptics saw the weakness in this approach. In front of the Royal Commission that investigated the Stock Exchange in 1878, Davies was asked if his reporters and operators were “liable to be imposed upon” by jobbers within the Stock Exchange. Davies responded unequivocally that it had “never ... happened,” though he admitted that the most common method for collecting prices was simply “ask[ing] the dealer[s]” in the market.<sup>36</sup> Rather than the low-level clerks or fraud perpetrated by outside brokers and bucket shops, it was an alliance of convenience forged between Extel and the jobbers of the London Stock Exchange that produced the prices reported over the ticker tape.

It was difficult to institute reforms and discipline on the price-reporting system that did not disrupt either speed at which prices were transmitted or the delicate webs of social trust that Extel’s reporters relied upon to collect prices. That did not prevent certain groups within the London Stock Exchange from trying. In 1900, Norman Herbert, the head of Extel’s operations on the trading floor, argued that a new system should be installed to report more accurate prices. He proposed that every price slip “handed in by jobbers [be] countersigned” by at least one other member corroborating the price. Herbert was opposed not only by stock jobbers but also by his bosses at Extel. The alliance between jobbers and Extel was mutually reinforcing. The jobbers almost unanimously opposed the reform because it implied “a doubt of their reliability,” and the managing director of Extel was “very reluctant to put it in force” because it was “only by the courtesy of the jobbers that [Extel] are enabled to obtain prices.”<sup>37</sup> Reforms meant to regulate and routinize the reporting of pricing information risked destroying the informal trust between jobbers and Extel reporters. The managers of the stock exchange, on the other hand, jumped at the opportunity to have more safeguards and regulations around the distribution of prices via the ticker, regulations which expanded their own power over how prices were distributed. They instructed Herbert to inform the directors of Extel that “all prices tendered to [Extel] for quotations by members should be verified by the signatures of 2 members or firms.”<sup>38</sup> Implicit in the new arrangement was that one of the two firms signing the slip was a brokerage firm, as every deal in the stock exchange was ostensibly

36. *Royal Commission on Origin, Objects, and Constitution of the London Stock Exchange*, 1878, 351, Parliamentary Papers.

37. London Stock Exchange, Managers Minutes of Subcommittees relating to the Exchange Telegraph Co, MS/14608/03, 54–55, Guildhall Library.

38. *Ibid.*

done between a broker on the one hand and a jobber on the other. It was a blow to the power of jobbers on the London Stock Exchange but helped both brokerage firms and the managers exert more power over what prices were reported.

Before stock prices were ever sent out over Extel's ticker tape wires, they were subject to power struggles between particular social forces within the London Stock Exchange itself. Although Extel's low-level employees were viewed as potential sites of corruption, it was the brokers, jobbers, and stock exchange managers who did the most to report prices that accurately represented *their* version of the market. For all of its abstractive power, the technology of the ticker tape was still beholden to the social dynamics and politics of the trading floor that it is often claimed to have superseded.

### Transmission

Politics and the struggle for social power over financial information did not end when prices were transmitted over the electrical wires. The mundane technical details of transmission and the material infrastructures that carried the electronic signals of prices to subscribers became crucial sites of power struggles in the shaping of nineteenth-century financial markets. Through the implementation of its ticker tape infrastructure, Extel was able to centralize power over financial markets, stockbrokers, and investors alike by controlling the information that passed through the ticker tape system. Instead of an abstract and simultaneous market that was available to all who had a ticker tape, the physical infrastructure of the ticker tape system imposed new inequalities and hierarchies on the financial system.

Extel's initial infrastructure of transmission was tightly circumscribed by the physical constraints of the London Stock Exchange and the electrical constraints of transmission. From its entry to the stock exchange in November of 1872 until its expulsion in 1885, Extel was forced to work from a small vestibule in a hallway outside of the stock exchange's main trading floor.<sup>39</sup> Although Extel had had the opportunity to take larger offices in the Stock Exchange, the offices were farther away from the trading floor and would have impeded the speed at which Extel reported prices.<sup>40</sup> The smaller offices presented Extel with

39. See London Stock Exchange, Trustees and Managers Minutes, 1868–1872, MS/19297/6, 211–213; and Trustees and Managers Minutes, 1872–1874, MS/19297/7, 260, 264, Guildhall Library.

40. London Stock Exchange, Appendix to Trustees and Managers Minutes, 1875–1881, MS/19514/003, 10 January 1878, Guildhall Library.

a stark fact: there was not nearly enough space to house the amount of batteries and circuitry needed to work the entire ticker tape system from the London Stock Exchange itself.<sup>41</sup> Unlike the New York Stock Exchange, where ticker tape companies placed equipment in upper floors, spatial constraints forced Extel to develop a different system to transmit its prices.

The keystone to Extel's system was a relay within the Bartholomew House, a building on the northwest corner of the stock exchange at the intersection of Throgmorton Street and Bartholomew Lane. Prices were sent from the telegraphist in the stock exchange vestibule through the relay in Bartholomew House back to Extel's headquarters at 17 and 18 Cornhill. Using a room full of battery power, the stock prices were simultaneously sent from the Cornhill headquarters to every ticker tape on each of the different circuits that Extel serviced. Bartholomew House was not only a key waypoint for sending prices from the Stock Exchange back to Extel headquarters, but it also provided two other important affordances. Overhead wires were run directly across the roof of the Royal Exchange from Extel's headquarters on Cornhill Street to Bartholomew House, and shorter wires were then laid directly from the Bartholomew House relay to stockbrokers' offices in Angel Court, Copthall Court, and Austin Friars (see [Figure 1](#)). Because of the length of the wire required and the challenge of finding wayleaves, running reliable overhead wires directly from Cornhill into stockbrokers' offices would have been enormously difficult without a station at the Bartholomew House.<sup>42</sup>

The question of where, *specifically*, Extel ran its cables and wires was always more than a simple technical problem. Bartholomew House was home to the offices of numerous stockbrokers. The large firms that could afford the expensive offices directly connected to the stock exchange itself were also the first firms that could afford to try the ticker tape. Initially, Extel did not actually have an office in Bartholomew House and instead relied on its first customer, the stockbroking firm of Borthwick and Wark, for space. A seven-wire cable was run from Cornhill, above the Royal Exchange, and into the offices of Borthwick and Wark, where it then ended, and six "single wires radiate[d] from it to the offices of other subscribers"; the last wire was saved for transmitting prices from the stock exchange back to Cornhill.<sup>43</sup> The technical needs

41. Exchange Telegraph Company, Correspondence, Reports, etc. Relating to the London Stock Exchange, 1877–1897, Diary of William Davies, 16 April 1886, MS/23028, London Metropolitan Archives.

42. Exchange Telegraph Company, Engineer's Report Book, MS/23075, 156–158, London Metropolitan Archives.

43. GPO Memorandum, 19 July 1872, Exchange Telegraph Company License, File 5, Post/30/371A, British Telecom Archive.

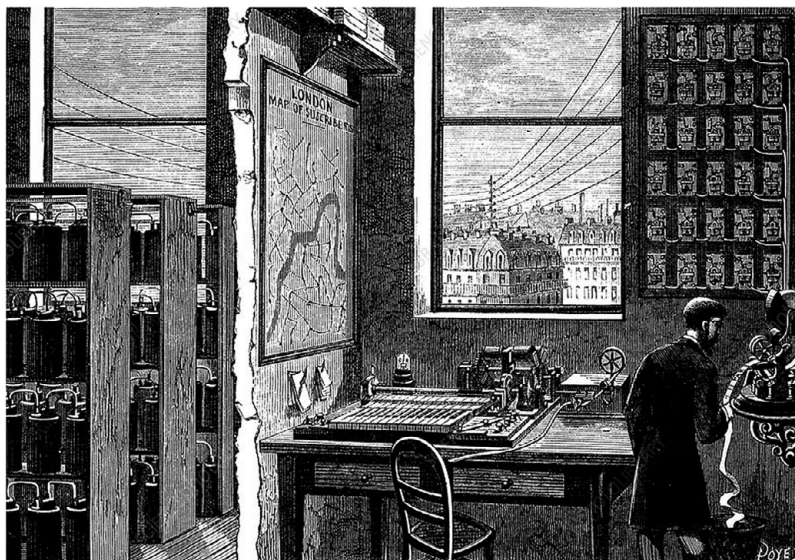


Figure 1. Extel's Headquarters at Cornhill

of Extel immediately threw Borthwick and Wark under suspicion that they gained extra benefits from the placement of these wires within their offices. The GPO sent an inspector to Borthwick and Wark's office to ascertain whether "messages intended for other subscribers [were] received [first] by Messrs. Borthwick & Co. from the company at their office and thence by them transmitted to the subscribers." Moreover, the GPO asked if "any instruments for transmitting telegrams [have] been set up in Messrs. Borthwick's office and connected with the wires passing through it?"<sup>44</sup> Put more simply, were Borthwick and Wark using their critical position within Extel's infrastructure for their own gain? The answer was ultimately "no," as a GPO inspector determined that Borthwick and Wark's office was simply used as a wayleave for Extel's system, which "shortened the journey of the messages from the Stock Exchange," and no "practical mischief results from such infringement."<sup>45</sup> Although the GPO ultimately ruled in favor of Extel, the anxiety and effort that went into ascertaining the truth pointed to how deeply politicized the simple act of laying wires could be.

Within a year, the ticker tape service proved so popular that Extel struggled to stay within the remit imposed by the GPO and London

44. Letter from the solicitor to the GPO, 3 September 1872, Exchange Telegraph Company License, File 5, Post/30/371A, British Telecom Archive.

45. Letter to the Engineer in Chief of the GPO, 19 September 1872, Exchange Telegraph Company License, File 5, Post/30/371A, British Telecom Archive.

Stock Exchange. By May of 1873, at the urging of “19 influential firms,” the London Stock Exchange repealed its resolution that Extel could only send its prices to members of the stock exchange.<sup>46</sup> The managers primarily intended for other financial institutions to have access to the ticker, most notably banks and insurance companies. Extel saw other opportunities, namely, the extension of services to three new locations: newspaper offices on Fleet Street, the clubs of London’s West End, and the stock exchanges in Britain’s provinces. Each one of these additions would have substantially exceeded the GPO’s requirement that it circulate prices only within nine hundred yards of the Stock Exchange. After wrangling with the GPO’s solicitors, both sides found a more flexible interpretation of the initial license. If Extel set up a second office in the West End near Charing Cross, prices could then be distributed to “the offices, residences, clubs, or hotels ... [of] other persons having business with or upon the Stock Exchange in the City of London,” as long as these locations were within a nine-hundred-yard radius of the new office.<sup>47</sup>

Even for the new offices in Charing Cross, the nine-hundred-yard radius quickly proved too limiting a constraint. Extel and its customers constantly pressured the GPO for the extension of wires and regulatory licensing to include private clubs and newspapers that fell beyond this radius. According to Extel, the farther away clubs and newspapers were from both Extel’s offices and the stock exchange itself, the more in need they were of ticker tape services. The Temple Club was one example. Located off Arundel Street in the Temple near the present site of King’s College, the club had numerous “members who are on the Stock Exchange.”<sup>48</sup> During the day, club members periodically received “a list of prices from brokers in the City,” yet, because of the distance from the Temple to the City, the prices “arrive[d] by hand, too late for any practical use.”<sup>49</sup> Club members urged both their brokerage firms and Extel to extend ticker tape services to the club’s location. The GPO remained skeptical of exceeding the license and renting a wire to Extel for the transmission of prices to the Temple Club. If Extel supplied one club with a wire beyond its licensing limit, what was to stop a slew of other institutions beyond Extel’s operating remit from receiving ticker tape service as well?

46. London Stock Exchange, Trustees and Managers Minutes, 1872–1874, MS/19297/7, 129–130, Guildhall Library.

47. Letter from Solicitor to the GPO, 7 October 1874, Exchange Telegraph Company License, File 14, Post/30/371A, British Telecom Archive.

48. Report from Alan E. Chambre, 29 October 1874, Exchange Telegraph Company License, File 14, Post/30/371A, British Telecom Archive.

49. Letter from Extel to GPO, 27 October 1874, Exchange Telegraph Company License, File 14, Post/30/371A, British Telecom Archive.

The GPO eventually had to confront the transformations Extel's financial technology was ushering in to late Victorian Britain, especially the ticker tape's unique asymmetry. In a lengthy internal memo, one GPO official noted Extel's peculiar system in which an office could "be placed on [only] one wire without detriment to the proper working of their system ... as the wire is for use in one direction only and for a purpose quite foreign to that which an ordinary private wire is devoted."<sup>50</sup> Because Extel only transmitted prices *outward*, the ticker tape did not erode the GPO's business but, in fact, drove more customers to use it, as they sent their orders back to the stock exchange through the GPO's metropolitan telegraph service. Between 1872 and 1874 alone, the GPO's metropolitan telegraph messages had increased from four thousand a week to thirteen thousand a week. The memo expressed the GPO's fear that failing to extend the remit of Extel's license would "stop any further increase of such messages."<sup>51</sup> Instead of diverting business away from the GPO, Extel's service was increasingly central to the revenues and expansion of the GPO's metropolitan telegraph service.

Not only had Extel's infrastructure ushered in a technological transformation of how financial markets operated but it also ushered in a social transformation of who was connected to financial markets. In a memo, the GPO was forced to admit that the restriction of the distribution of prices to "other persons having business with or upon any such stock or commercial exchange" in Extel's original license was close to meaningless.<sup>52</sup> If the definition of "other persons" was to be adhered to, "nearly everyone in the Kingdom might come within this category, inasmuch as all persons have had during their lives some business with or upon the Stock Exchange."<sup>53</sup> By 1876, the GPO believed that it was "impolitic for the Post Office to stand in the way of public convenience in matters which it cannot itself undertake."<sup>54</sup> The GPO formally altered Extel's license later that year. Extel had to pay an increased royalty to the GPO for renting wires but was otherwise given free rein. Most importantly, all qualifications for new subscribers were eliminated and the service radius from any Extel office was extended to one mile.<sup>55</sup> The dramatic social expansion of those with access to ticker

50. Report from Alan E. Chambre, 29 October 1874, Exchange Telegraph Company License, File 14, Post/30/371A, British Telecom Archive.

51. GPO Memorandum, 3 November 1874, Exchange Telegraph Company License, File 14, Post/30/371A, British Telecom Archive.

52. *Ibid.*

53. *Ibid.*

54. Letter from the GPO to HMS Treasury, 14 August 1876, Exchange Telegraph Company License, File 17, Post/30/371A, British Telecom Archive.

55. Letter from Alan E. Chambre to Secretary of the GPO, 14 March 1876, Exchange Telegraph Company License, File 16, Post/30/371A, British Telecom Archive.

tapes had fundamentally reshaped the GPO's ability to police and regulate Extel's new financial technology. A new investing public, the GPO believed, could no longer reasonably be denied access to financial information based on outdated norms of communications law.

### Expanding the Ticker Tape

Between the GPO's extension of Extel's operating license and the London Stock Exchange allowing nonmembers to subscribe to the ticker tape, the mid-1870s to early -1880s were a time of rapid expansion for Extel. In 1886, Extel's chairman proclaimed to the shareholders that "the financial business ... has touched the highest remunerative point in the history of the company, and this is due in a very great measure to the increased facilities afforded to members of the stock exchange."<sup>56</sup> By 1887, Extel had opened offices in Liverpool, Manchester, Leeds, Glasgow, Edinburgh, and Brighton, in addition to those it already had in London. These offices serviced a total of 903 ticker tape instruments throughout the country by 1893. Although the geographic distribution of subscribers was more varied than in the past, the ticker tape business was still highly skewed to London. A total of 537 of the financial service ticker tapes were located in London, whereas only 15 were in Manchester, 12 were in Liverpool, and 3 were in Brighton.<sup>57</sup> It is important to note that these ticker tapes were not a local system unto themselves. Ticker tapes in Manchester did not transmit Manchester stock exchange prices to Manchester brokers. Extel's services in the provinces circulated London prices to provincial brokers and reported the prices of select local securities back to London subscribers. Thus, the ticker tape service in the country was mostly used for arbitrage trading with London but did not aid London brokers arbitraging with the provinces. Although Extel did not conduct services internationally, it had a network of reporters that sent in stock prices and news from New York, Paris, Berlin, and Frankfurt at select intervals (not the continuous reporting of price changes London's service enjoyed).<sup>58</sup>

56. Exchange Telegraph Company, Annual General Meetings, 1886, MS22964/1, London Metropolitan Archives.

57. The other 336 ticker tapes were operated for nonfinancial services. See Exchange Telegraph Company, Annual General Meetings, 1893, MS22964/5, London Metropolitan Archives.

58. See Exchange Telegraph Company, Expenditure and Revenue Accounts of the Offices in Liverpool, Manchester, Glasgow, Edinburgh, and Brighton, MS/22981; and Annual General Meetings, 1893, MS22964/5, London Metropolitan Archives. It



The asymmetrical nature of the ticker tape service reinforced broader asymmetries in the financial world. London's prices circulated broadly via the ticker tape and helped make London "the centre to which the bulk of investment and speculative business naturally flows."<sup>59</sup> The provincial stock exchanges were increasingly forced to do business with London whereas the reverse was not true.<sup>60</sup>

The increase in the number of people who had access to ticker tape services necessitated an expansion of Extel's material infrastructure. Infrastructural expansion came with both technical and political challenges. One of the principal problems Extel faced was simply how to engineer a system that could simultaneously broadcast rapid price changes to hundreds of different ticker tape instruments at the same time. The problem was compounded by the general lack of electrical standards in late nineteenth-century Britain. The definitions of standard measurements like the ohm (electrical resistance), the volt (electrical power), and the ampere (electrical current) were hotly debated between scientists and telegraphic engineers alike. Standard definitions were not adopted until the International Electrical Congress of 1881 and the practical adoption of these standards within telegraphic and other electrical systems was more elusive still.<sup>61</sup>

In practical terms, the unique nature of Extel's ticker tape service was a difficult engineering problem for the GPO, which rented Extel many of its first wires. Extel's service relied on 2,000 battery cells that produced close to 200 volts of electricity, which in turn created an average electrical current on transmitting wires of 35 amperes.<sup>62</sup> In contrast, the typical GPO telegraphic system used 120-volt charges and a maximum of 20 amperes of electrical current per wire.<sup>63</sup> The elevated levels of electrical current required by ticker tape transmission severely damaged GPO wires. In 1876, GPO engineers warned their superiors that wires were frequently "harmed" and "injured" by Extel's

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is also important to note that many foreign stock exchanges, like Paris, did not even have a local ticker tape service at all. See Preda, *Framing Finance*, 113–127.

59. Armstrong, *The Book of the Stock Exchange*, 141.

60. Campbell, Rogers, and Turner argue that, by the end of the nineteenth century, "the uniqueness of the provincial markets had virtually disappeared and they were increasingly in direct competition with London." Campbell, Rogers, and Turner, "From Complimentary to Competitive," 526.

61. For the best summary of this process, see Hunt, "Doing Science in a Global Empire," 323–329; Hunt, "The Ohm is Where the Art Is"; Schaffer, "Late Victorian Metrology and Its Instrumentation."

62. Exchange Telegraph Company, Engineer's Report Book, MS/23075, 236–238, London Metropolitan Archives. One should think of the amount of voltage as the electrical "road" over which messages travelled, whereas the amperage measures the actual "traffic." My thanks to Adam Mackenzie for this analogy and for his help deciphering the reports and diagrams of nineteenth-century electrical engineers.

63. See *Technical Pamphlets for Workmen*, 26–28.

“strong currents.” Any further wires that the GPO rented to Extel needed to be “carefully watched.”<sup>64</sup> Under its new operating license, Extel was liable for any damage that occurred to rented GPO wires. Although the GPO did its best to avoid renting Extel the wires that connected ticker tapes to the central transmitter and batteries, it still forced Extel to rent the wires that connected the company’s offices in the provinces with its headquarters in London. The hypocrisy of the GPO was less frustrating to Extel’s management and shareholders than the perceived inefficiencies of such a system. “It seems preposterous at the end of this 19th century that public opinion can support the strained monopoly of a government department founded for the benefit of the public, in a policy which for its narrowness is unworthy a private company,” Extel’s 1892 annual report complained.<sup>65</sup>

Frustrated by the inability of the GPO’s wires to handle ticker tape transmission, Extel built an extensive private infrastructure of wires wherever it could. Frederick Higgins, Extel’s chief engineer, urged the replacement of GPO rental lines with Extel’s private wires “owing to the superior conductibility of *our* wires over those of the Post Office.”<sup>66</sup> Extel embarked on extensive construction projects and by the end of the nineteenth century had erected nearly two hundred miles of private wires, primarily in London.<sup>67</sup> Although many competing telecommunications companies, local political authorities, and the GPO attempted to limit Extel’s infrastructural expansion, by the early 1900s the company claimed to have triumphed over all the obstacles in its way.<sup>68</sup> Extel’s private infrastructure of wires took pride of place in the company’s early twentieth-century advertising material. The reason why

64. Letter from Alan E. Chambre to the Secretary of the GPO, 10 July 1876, Exchange Telegraph Company License, File 16, Post/30/371A, British Telecom Archive.

65. Exchange Telegraph Company, Annual General Meetings, 1892, MS22964/4, London Metropolitan Archives.

66. Exchange Telegraph Company, Engineer’s Report Book, MS/23075, 207, London Metropolitan Archives.

67. Exchange Telegraph Company, Annual General Meetings, 1893, MS22964/5, London Metropolitan Archives.

68. There are numerous examples of the legal and political fights that Extel became embroiled in during the 1880s and 1890s. The most salient was an extended legal dispute between Extel and the United Telephone Co regarding wire space over the roof of the Royal Exchange into the Stock Exchange. Extel also faced stiff opposition from various London metropolitan authorities, especially the Sewage Commissioners, who opposed Extel’s attempts to move their wiring underground. Telecommunications companies, the sewage commissioners argued, “had already interfered with the streets to an objectionable extent.” See Exchange Telegraph Company, Engineer’s Report Book, MS/23075, 135; and Papers Concerning Telephone and Telegraph Equipment: Affidavit by Frederick Higgins in a High Court case against the United Telephone Co Concerning Rooftop Telegraph Wires, MS/23081, London Metropolitan Archives.

Extel provided “the most perfect” service, the company boasted, was because “the wires belong to the company” and were thus of a higher quality and received more immediate maintenance than any other telecommunications infrastructure in Britain.<sup>69</sup> The technical challenges of creating a material infrastructure capable of transmitting Extel’s information were turned into a key advantage for the company over its competitors.

Extel’s infrastructure of offices, wires, and ticker tapes allowed for the expansion of its business beyond just financial news and stock prices by the mid-1880s. Responding to the “insatiable ... demand for news and intelligence of all kinds,” Extel leveraged its network of contacts throughout Britain and Europe, as well as its transmission infrastructure, to provide a much wider range of services for customers that included general news, parliamentary news, sporting news, and commercial news.<sup>70</sup> In order to provide these new services Extel was forced to expand and specialize its material infrastructure even more than it already had.

Unlike the financial service that sent out updates to changing stock prices, other news services needed to rapidly transmit far larger pieces of information like news stories or parliamentary speeches. The necessity of communicating different and larger amounts of information forced Extel to develop new technologies and infrastructures beyond the ticker tape. One key innovation that helped Extel transmit different types of news was the clumsily named “telegraphic type-printing transmitter,” a machine that combined the continual updates of the ticker tape with the capabilities of a modern-day fax machine.<sup>71</sup> A reporter transmitted a news story or a speech from Parliament and the printing transmitter printed out the story in real time at a length of up to “ten thousand words for each sitting.”<sup>72</sup> The introduction of the printing transmitter created new technical challenges for Extel as the machine required even more “powerful” working electrical currents than a ticker tape. In fact, the printing transmitter required so much extra electrical current that it caused “breakdowns” on circuits with “other descriptions of instruments,” like ticker tapes. Extel’s chief

69. Exchange Telegraph Company, Correspondence, Reports, etc. Relating to the London Stock Exchange, 1877–1897: Advertising Announcement of New Telephone Service, MS/23028, London Metropolitan Archives.

70. Exchange Telegraph Company, Annual General Meetings, 1888, MS22964/1, London Metropolitan Archives.

71. See Exchange Telegraph Company, Instructions for the use of ETC telegraphic instruments, MS/23080, London Metropolitan Archives.

72. Exchange Telegraph Company, Copy of the *Times* with a full page advertisement by ETC titled “How the Newspapers Get Their News,” MS/23123, London Metropolitan Archives.

engineer admitted that “not more than three of these instruments [would] work on one circuit” even with no other instruments attached.<sup>73</sup>

The introduction of new services and new instruments made the management of Extel’s transmission network an even more fraught endeavor. Circuits had material limits: only about twenty normal ticker tape instruments could be placed on a circuit at the same time before the system overloaded.<sup>74</sup> Managing the limits of the transmission network was further complicated by the fact that newer and faster ticker tapes could not work from the same central transmitter as slower, older ones, and they had to be kept on entirely different electrical circuits.<sup>75</sup> When Extel did upgrade ticker tapes, it had to upgrade all of the ticker tapes on a circuit at once and could not simply swap in new machines one at a time.<sup>76</sup>

Managing the flow of information thus became bound up with managing the physical infrastructure of transmission. One example was Extel’s difficulty in managing its ticker tapes in Westminster near Parliament. Most of the ticker tapes and printers in Westminster were only subscribed to the “general” news system, but those tickers were on the same circuit as tickers and printers connected to the “parliamentary” news service. “The practice of sending special general news of any importance on [the] Parliamentary [circuit] is objectionable,” an engineer informed Extel’s management, “because there are 28 instruments on that line and only 6 subscribers entitled to such matter.”<sup>77</sup> The engineer recommended shutting down the entire parliamentary service, a suggestion that Extel did not take. Extel’s ticker tape infrastructure was also at the mercy of more pedestrian forms of interference. In 1887, the landlords of the Fitzroy Club on Cleveland Street seized the club’s two ticker tapes as collateral for late rent and in the process cut the ticker’s wires, disrupting the service to nine other customers whose tickers were on the same circuit.<sup>78</sup>

In order to manage the different services, instruments, wires, transmitters, and electrical current that comprised its increasingly diverse

73. Exchange Telegraph Company, Papers Concerning Telephone and Telegraph Equipment: Report on Mr. Higgins’ Type Printing Telegraphic Apparatus, 11 October 1898, MS/23081, London Metropolitan Archives.

74. Exchange Telegraph Company, Engineer’s Report Book, MS/23075, 230, London Metropolitan Archives.

75. Exchange Telegraph Company, Annual General Meetings, 1892, MS/22964/4, London Metropolitan Archives.

76. Exchange Telegraph Company, Annual General Meetings, 1893, MS/22964/5, London Metropolitan Archives.

77. Exchange Telegraph Company, Engineer’s Report Book, MS/23075, 301–302, London Metropolitan Archives.

78. *Ibid.*, 214.

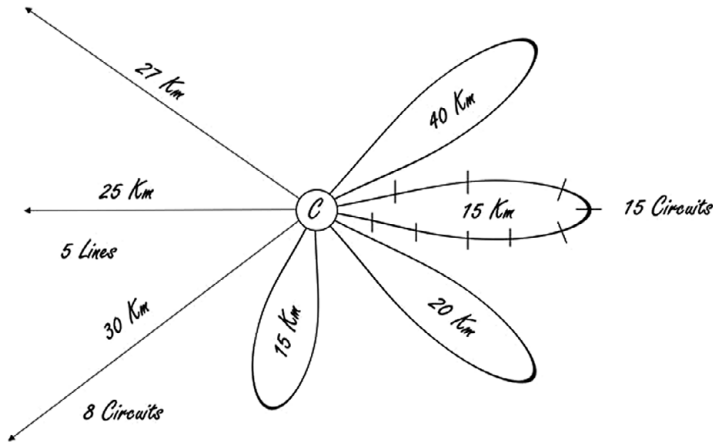


Figure 2. Extel's Operating Circuits circa 1887

set of offerings, Extel was forced to specialize its electrical circuits during the 1880s and 1890s. Figure 2 shows the rough plan of circuits that Extel utilized within London and how circuits were separated.<sup>79</sup> The *C* in the center of the map is Extel's central Cornhill headquarters from which all prices and information were transmitted. The four complete loops to the right were the financial wires, which ran from Cornhill to the Stock Exchange, to broker's offices north of the stock exchange near Austin Friars, Angel Court, and Copthall Court, and south of Cornhill to the banks on Lombard Street. The three lines to the left were the wires that ran from Cornhill to Westminster and Parliament, the clubs and outside brokers of the West End, and the newspapers on Fleet Street. Some regions were busier than others. In 1888, the Fleet Street circuit had ten miles of wiring but only eleven working instruments, whereas the City had over twenty-five miles of wiring that serviced fifteen different circuits, each of which had twenty ticker tapes apiece.<sup>80</sup>

Technical details are always more than just technical details. Extel's private infrastructure of offices, wires, ticker tapes, and the limitations of that material infrastructure directly shaped how the flow of financial information was controlled and who had access to it. The centralized and private nature of the ticker tape service gave Extel the power to send different information across different circuits: a ticker tape located in

79. For the sketches this figure is based on, see Exchange Telegraph Company, Instrument Test reports, Circuit Plans, Prices of Parts, and Specimen Telegraphs, MS/23083, London Metropolitan Archives. My thanks to Stuart Shook for creating this reproduction.

80. Exchange Telegraph Company, Engineer's Report Book, MS/23075, 221–222, 271, London Metropolitan Archives.

the City on the financial service provided different information (and different prices) than a ticker located in the West End on the “commercial” or “general news” service. The decision over what information was sent and to whom had been powerfully centralized by Extel through the material infrastructure that underpinned the ticker tape.

### The Social Consequences of the Ticker Tape

The political and social problem of managing who had access to the market became suddenly and deeply entangled with the technical problem of operating the ticker tape in 1885, when the London Stock Exchange expelled Extel from the premises. Ticker tape service continued unabated from the Bartholomew House relay, but the quotations that appeared on the tape could no longer be called “official” or even exclusive, as the formal connection with the stock exchange had been broken. Stockbrokers believed that Extel’s supply of price quotations to outside stockbrokers and bucket shops was draining business away from the London Stock Exchange. Outside brokers’ adoption of the ticker tape and subsequent ability to make prices for investors without recourse to official stock exchange brokers became an issue of great importance to the City’s financiers. Throughout 1884, private letters circulated within the Stock Exchange, condemning the “present unprecedented stagnation of business” as the fault of “outsiders having the prices furnished [to] them direct from the house by means of the exchange telegraph company’s machine.” Many members of the London Stock Exchange believed that outside brokers were, thanks to the ticker tape, “rendered independent of the stock exchange itself but ... subsist and thrive upon the information derived therefrom.”<sup>81</sup>

The problem of outside brokers transacting financial business had been a thorny one for stock exchanges throughout Britain. In London, outside brokers had a number of advantages. They could advertise in newspapers and periodicals to increase their clientele, a practice stock exchange brokers were explicitly barred from. Additionally, outside brokers were not subjected to the same capital requirements or legal strictures that bound members of the London Stock Exchange. Thanks to the ticker tape, continuous, up-to-date pricing information was no longer sheltered within the London Stock Exchange itself. Outside

81. Exchange Telegraph Company, Correspondence, Reports, etc. Relating to the London Stock Exchange, 1877–1897: Letter from C. A. Streeten For Circulation Amongst Members of the Stock Exchange Only, 19 December 1884, MS/23028, London Metropolitan Archives.

brokers executed deals at or around the market price and had the information to *prove* that the prices they quoted were accurate.<sup>82</sup>

In 1886 Extel was readmitted under a new contract that established the managers of the stock exchange in a “much more authoritative position.”<sup>83</sup> On the one hand, Extel was allowed to expand its operations. Two Morse operators were permitted, one at each end of the trading floor, and a new service called the “challenge system” was introduced, whereby subscribers could telegraph or telephone the head office and ask for quotes of particular shares to be sent out on the tape. In order to give stockbrokers easier facilities to use the new challenge system, Extel was also allowed to provide telephones to stockbrokers, though it was prevented from installing telephones on the trading floor itself.<sup>84</sup>

The London Stock Exchange demanded severe concessions from Extel in exchange for the new facilities. Extel was forced to “decline any further applications from outside brokers,” and agreed to “do their best [to] gradually eliminate all outside dealers and brokers ... as subscribers to the tape.”<sup>85</sup> Furthermore, the stock exchange now had the final say over every quotation sent out over the tape and over every new subscriber Extel wished to add. Extel had to submit each new request for a ticker tape to the Committee for General Purposes of the London Stock Exchange for their approval. In order to secure a monopoly over the distribution of official stock exchange price quotations, Extel forfeited its power to select its own clients and discriminate which prices it sent out over the tape.

The new arrangement was a harrowing test of financial and political fortitude for Extel. Entirely new infrastructures had to be constructed not just for business expansion, but for the *exclusion* of outside brokers. “In carrying out these new arrangements,” Davies wrote, “we had to run entirely new circuits for members so as to cut out outsiders from the telephone and challenge system, thus incurring additional permanent charges [and] attending a duplicate staff and maintenance.”<sup>86</sup> Infrastructure was expensive. Extel reported spending £1,856 on the

82. See Taylor, “Inside and Outside the London Stock Exchange.”

83. Exchange Telegraph Company, Correspondence, Reports, etc. Relating to the London Stock Exchange, 1877–1897: Meeting of the Trustees and Managers Committee, 7 July 1886, MS/23028, London Metropolitan Archives.

84. Exchange Telegraph Company, Correspondence, Reports, etc. Relating to the London Stock Exchange, 1877–1897: Agreement between London Stock Exchange and Exchange Telegraph Co., 22 June 1886, MS/23028, London Metropolitan Archives.

85. *Ibid.*

86. Exchange Telegraph Company, Correspondence, Reports, etc. Relating to the London Stock Exchange, 1877–1897: William Davies, internal Extel Memorandum, 29 November 1893, MS/23028, London Metropolitan Archives.

erection of new circuits and an additional £13,337 on maintenance and staff. In a desperate attempt to make up the revenue it was losing from the lapsing contracts of outside brokers, Extel lowered prices for members of the stock exchange, hoping to gain new clients. It did not. In total, Davies estimated the London Stock Exchange's new regulations cost Extel £32,144 over the course of seven years.<sup>87</sup>

Part of the problem were the contracts Extel had signed with outside brokers before 1886. Legally, Extel could not simply shut off ticker tape services to these customers. However, Extel's infrastructure provided an elegant technical solution. Davies informed the managers of the London Stock Exchange that because "the instruments used by outsiders are on entirely different circuits to those used by members ... the information supplied can always be regulated as may be found necessary."<sup>88</sup> Not long afterward, Extel began shifting the service it provided outside brokers from the "financial" service to the new, amorphously named "commercial" service. Prices were still transmitted, but instead of the two prices normally used in the exchange—a bid and an ask price—the commercial service only sent out the *middle* price, effectively precluding outside brokers from knowing what the actual buying and selling price of stocks were. Moreover, middle prices were not updated continuously but only sent out at certain "intervals throughout the day."<sup>89</sup> The managers of the London Stock Exchange also worried that their own members would take bribes from outside brokers to jury-rig their tapes onto the circuits used by members. Once again the material technicalities of Extel's system proved beneficial. Ticker tapes illegally added onto circuits would "not be attached to the company's [central] batteries," which prevented them from functioning.<sup>90</sup> The material limits of the ticker tape and its circuits had, in fact, provided a technical solution to one of the largest social problems the London Stock Exchange faced in the nineteenth century.

Extel also assiduously policed the physical placement of its ticker tapes to prevent their use by members of the public and outside brokers alike. The years after 1886 saw Extel engage in the ruthless removal of

87. *Ibid.*

88. Exchange Telegraph Company, Correspondence, Reports, etc. Relating to the London Stock Exchange, 1877–1897: Letter from William Davies to the London Stock Exchange, 13 May 1886, MS/23028, London Metropolitan Archives.

89. Exchange Telegraph Company, Correspondence, Reports, etc. Relating to the London Stock Exchange, 1877–1897: Diary of William Davies, 20 June 1894; and "Extract," 1 October 1894, MS/23028, London Metropolitan Archives.

90. Exchange Telegraph Company, Correspondence, Reports, etc. Relating to the London Stock Exchange, 1877–1897: Letter from William Davies to the London Stock Exchange, 16 April 1886, MS/23028, London Metropolitan Archives.



ticker tapes from restaurants, hotels, and clubs where the “publicity of the tape [was] objected to.”<sup>91</sup> Some affluent clubs protested, but Extel removed their machines all the same because “all members of the high-class clubs, if wanting to deal on the stock exchange, can have no difficulty in dealing through a broker.”<sup>92</sup> Restaurants and hotels frequently constructed separate ticker tape rooms “to which no one but subscribers were admitted,” yet they were not spared either.<sup>93</sup> Extel even sent inspectors to root out more nefarious placements of ticker tapes. One London stock exchange member named A. Moreton Mandeville had his offices next to a bucket shop deceptively named the London and Paris Exchange. Upon inspection, Extel found a door inside Mandeville’s ticker tape room that led “into another office” presumably the bucket shop next door, and Mandeville’s ticker tape was promptly removed.<sup>94</sup>

Despite all of the control over material infrastructure that Extel exercised, there were no easy technical solutions to the social problem of who should have access to the market. The mass adoption of the ticker tape by outside brokers before 1886 had unleashed new social dynamics within financial markets that were nearly impossible to stop. Although some outside brokers, particularly bucket shops, merely had clients bet on the movement of prices on the tape itself (without actually ever purchasing the underlying security), they were the minority. Many outside brokers did legitimate business by aggregating small, often speculative, orders from clients and then processing them with official brokers on the London Stock Exchange. The average outside broker funneled business to the London Stock Exchange “employing one or more members as necessary to transact their business thereon and ... sharing the commission.” Davies strenuously attempted to demonstrate the importance of outside brokers to the managers of the London Stock Exchange. According to informal Extel estimates, outside brokers were responsible for “53 and a quarter million” pounds

91. Exchange Telegraph Company, Correspondence, Reports, etc. Relating to the London Stock Exchange, 1877–1897: Notice of Discontinuance to Outsiders Objected to by the Committee of the Stock Exchange, 23 June 1894, MS/23028, London Metropolitan Archives.

92. Exchange Telegraph Company, Correspondence, Reports, etc. Relating to the London Stock Exchange, 1877–1897: Letter from C. A. Streeten For Circulation Amongst Members of the Stock Exchange Only, 19 December 1884, MS/23028, London Metropolitan Archives.

93. Exchange Telegraph Company, Correspondence, Reports, etc. Relating to the London Stock Exchange, 1877–1897 Letter from the Bristol Hotel and Palmerston Co. to Extel, 27 June 1894, MS/23028, London Metropolitan Archives.

94. Exchange Telegraph Company, Correspondence with the Committee for General Purposes of the London Stock Exchange, 28 June 1897, MS/23030/1, London Metropolitan Archives.

worth of business on the Stock Exchange each year.<sup>95</sup> Outside brokers were a major source of revenue for members of the London Stock Exchange. Likewise, a good working relationship with official “inside” brokers was necessary for the successful operation of an outside brokerage.

In an effort to convince the London Stock Exchange that “the removal of instruments from outsiders will do little harm to anyone but the Exchange Telegraph Company,” Extel sent a survey to the fifty-eight largest outside brokers it serviced.<sup>96</sup> The survey asked for the amount of business done on the stock exchange by the outside firm, how many members of the stock exchange were used to execute that business, and “if the instrument is removed, will it stop your business?”<sup>97</sup> The fifty-eight firms were unanimous: The removal of the ticker tape would make no difference because they already had working relations with London Stock Exchange brokers who would continue to supply them with prices and place orders. One firm claimed that it found “the instrument useful, but in no way necessary.” Another firm noted that it could “always obtain prices from members of the house, who gladly give prices and execute orders,” whereas another said that “there would not be the slightest difficulty in getting the prices from our brokers directly.”<sup>98</sup> The ticker tape had helped forge mutually beneficial relationships between outside brokers and inside brokers and helped funnel business from smaller speculators into the formal London Stock Exchange. Extel’s survey also revealed that these social ties were there to stay, in large part facilitated by a new technology: the telephone. By the early 1890s, it was clear to the directors of Extel that “with the advantages of private telephones ... the tape is but an auxiliary.”<sup>99</sup>

95. Exchange Telegraph Company, Correspondence, Reports, etc. Relating to the London Stock Exchange, 1877–1897: William Davies, internal Extel Memorandum, 29 November 1893, MS/23028, London Metropolitan Archives. Davies was obviously incentivized to produce numbers that highlighted rather than downplayed the importance of outside brokers to the London Stock Exchange’s business. These figures are difficult to verify and contextualize because they represent flows and turnover of business, not easily measured, static amounts like share capital listed on the exchange.

96. Exchange Telegraph Company, Correspondence, Reports, etc. Relating to the London Stock Exchange, 1877–1897: Questionnaires Completed by Subscribers as to the Possible Effects on Their Business of the Removal of Extel Instruments, 1893, MS/23028, London Metropolitan Archives.

97. *Ibid.*

98. *Ibid.*

99. Exchange Telegraph Company, Correspondence, Reports, etc. Relating to the London Stock Exchange, 1877–1897: William Davies, internal Extel Memorandum, 29 November 1893, MS/23028, London Metropolitan Archives.

Extel and the London Stock Exchange both realized the limits of their ability to keep outside brokers at bay through the technology and infrastructure of the ticker tape. Throughout the late 1880s, Extel lobbied the London Stock Exchange to allow the introduction of a telephone service from the trading floor. After repeated petitions, the London Stock Exchange finally relented. The managers of the exchange recognized that Extel had willingly cut off “objectionable” outside brokerage firms from the ticker tape service and simultaneously understood the effects that the discontinuation of ticker tape service would have, namely, increased telephonic business between outside and inside brokers. “If [the committee of managers] threw obstruction in the way of business or rather if they did not increase the facilities and show the public that business could be done cheaper and better on the Stock Exchange than elsewhere, it would flow into other channels,” the managers admitted. Indeed, they were sure that “the telephone would be very useful to members and would make the stock exchange popular.”<sup>100</sup> In January of 1889, Extel opened the first formal call room on the trading floor of the London Stock Exchange.<sup>101</sup> Within two years, Extel was operating three call rooms in the stock exchange and was processing over fifteen thousand calls per month.<sup>102</sup> Although the ticker tape was used well into the twentieth century, by the end of the nineteenth, it was no longer a technology that could police the flow of financial information or determine the boundaries of the stock market.

## Conclusion

Faith in the ticker tape’s asymmetric system and Extel’s centralized control over the transmission of financial information led to its mass adoption by brokers within the London Stock Exchange and many outside of it during the late nineteenth century. Although the ticker

100. London Stock Exchange, Trustees and Managers Minutes, 1888–1891, MS/19297/12, 60–61, Guildhall Library.

101. Many historians have mistaken the fact that stockbrokers were using telephones before 1889 with the existence of a call room on the trading floor. Mary Poovey claims that a stock exchange call room was established in 1878, whereas Ranald Michie claims one was established by 1883. Neither cites any evidence for their claims. See Poovey, *The Financial System in Nineteenth-Century Britain*, xv; Michie, *The London Exchange*, 81. For evidence of when the call room was actually established, see Letter from Extel to the United Telephone Co, 23 November 1888, Royalty to be Paid on Telephone Extensions at Bartholomew House Exchange by the Exchange Telegraph Company, File 9, Post/30/1774, British Telecom Archive; “The Telephone at the Stock Exchange,” *The Electrician*, January 4, 1889, 243; Stein, “Ideology and the Telephone,” 82–83.

102. Exchange Telegraph Company, Annual General Meetings, 1891, MS/22964/3, London Metropolitan Archives.

tape made financial pricing information simultaneously and immediately available to a much wider swath of brokers and investors, the prices that were transmitted were still always subject to the social relations of the stock exchange floor. The prices the ticker reported were by no means objective or accurate, nor yet were they delivered equally to everyone with a ticker tape. Extel and the London Stock Exchange utilized the material infrastructure of the ticker tape system to police who had access to financial information and to disadvantage unwanted participants.

But technical solutions, no matter how powerful or well designed, are always subject to social forces. By the 1890s and early 1900s, the social relationships that had been forged between inside and outside brokers thanks to the ticker tape, persisted despite the London Stock Exchange's efforts to prevent the transmission of financial information to anyone beyond its official members. The ticker tape, and telecommunications more broadly, were never technologies that simply made markets more efficient or rational. Instead, they reconfigured the social relations of markets in complex ways, giving some participants the power to shape market behavior while leaving others at the whims of a market over which they had little control.

The history of the ticker tape's adoption by the London Stock Exchange was just one part of the larger material reordering of financial markets during the nineteenth century. Of course, financial markets have always been shaped by their material design and technological limitations and affordances, but the nineteenth century saw important, mass developments on this front.<sup>103</sup> Stock exchanges moved from the informal spaces of alleyways and coffee shops to purpose-built buildings. Telecommunication networks linked these buildings together at high speeds, facilitating the global flow of financial capital.<sup>104</sup> In many ways, the material ordering of financial markets introduced in the nineteenth century continued to serve as the basis for market operations until well into the twentieth century.<sup>105</sup>

The material ordering of financial markets was never neutral. Whether it was the way institutions and companies battled for control over the networks of material infrastructures—such as the London Stock Exchange and Extel or the New York Stock Exchange and Western Union—or how different social groups benefitted disproportionately from the technicalities of wire placement and circuit construction—such as the

103. See, for instance, Mackenzie, *Material Markets*.

104. See Müller and Tworek, "The Telegraph and the Bank."

105. Pardo-Guerra shows how many twentieth-century computerized and digital technologies were built on top of nineteenth-century systems. See Pardo-Guerra, *Automating Finance*, 75–79, 82–119.

official brokers of the London Stock Exchange and their outside competitors—the material ordering of financial markets has always been a product of power and has distributed economic gains unequally.<sup>106</sup> As the complexity of markets increased over the nineteenth and twentieth centuries, technical questions of how to build financial markets became inseparable from social and economic questions about who those markets should serve.

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106. Donald Mackenzie has recently called for a renewed focus on the study of “material political economy,” which is “the economically consequential material orderings [of financial markets] to which there are alternatives.” Mackenzie, “‘Making’, ‘Taking’ and the Material Political Economy of Algorithmic Trading,” 520.

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